EUKOCYTE ALLOANTIBODIES play a role in febrile and pulmonary transfusion reactions, immune neonatal neutropenia (INN), response to granulocyte transfusions, drug-related neutropenia, and autoimmune neutropenia.1 Many methods are available to detect leukocyte antibodies; however, the relationship of these tests to immune destruction of granulocytes, and thus to these different clinical situations, is not established.2 4 Because most of the assays are complex, there have been few studies comparing the value of different antibody methods in detecting clinical problems. For instance, in different reports, autoimmune neutropenia has been associated with antibodies detected by agglutination, cytotoxicity, immunofluorescence, opsonization, antibody-dependent cell-mediated cytotoxicity, and staphylococcal protein A.1 6 Immune neutropenia secondary to drugs may be caused by granulocyte agglutinins, opsonins, or cytotoxins1 3 and secondary to Felty's syndrome, by antibodies detected by antibody-dependent lymphocyte-mediated granulocytotoxicity.4 Transfusion reactions are associated with leukoagglutinins and lymphocytotoxins (HLA antibodies), while antibodies detected by both granulocyte agglutination and immunofluorescence have been found in INN. A poor response to granulocyte transfusions has been attributed to different antibodies, including leukoagglutinins, lymphocytotoxins,5 11 and those detected by immunofluorescence.12 11 Although others14 have reported no effect of granulocyte agglutinins, granulocytotoxins, or lymphocytotoxins on granulocyte intravascular recovery.

Until recently, there has not been a method available to study the in vivo fate of a single injection of a granulocyte suspension so that the effect of antibodies present at the time could be determined. The isotope 111-indium is an efficient granulocyte label, does not elute from the cell, and emits photons in high abundance, making it ideal for external body imaging.15 Thus 111-indium granulocytes can be used to determine both the intravascular kinetics and the extravascular localization of granulocytes.16 17 We have used 111-indium granulocytes to study the effect of leukocyte antibodies detected in five assays on the in vivo fate of granulocytes.

This report is an extension of our previous work.17 Thirty-five new studies were done using all five leukocyte antibody methods, and two additional antibody methods were applied to the 53 studies previously reported.

MATERIALS AND METHODS

This study was approved by the University of Minnesota's Committee of the Use of Human Subjects in Research. All participants gave informed consent. Subjects in this study were either patients who were receiving platelet or granulocyte transfusions or those for whom an indium scan had been requested for diagnostic purposes.
because localized infection was suspected. On the morning of the indium study, blood was obtained from the patients and normal donors. A suspension of donor granulocytes was prepared, labeled with \(^{111}\)indium, and injected into the intravascular kinetics and organ localization studies done during the subsequent 24 hours. A cross-match between the recipient’s serum and donor’s granulocytes and lymphocytes was done using five leukocyte antibody methods. Sometimes it was not possible to do all five crossmatches on the day of the indium study. In those cases, the patient’s serum from that day was stored at \(-70^\circ C\) and used for crossmatching later with granulocytes or lymphocytes freshly obtained from the original donor. The granulocyte donors met all of the criteria of the American Association of Blood Banks for whole blood donation and were hepatitis B, antigen negative. All of the methods used in this study have been reported in detail previously and are summarized here.

**Methods**

**Granulocyte agglutination.** Granulocyte agglutination (GA) was done as previously described\(^5\) using microtiter trays. The results were read after five hours of incubation at \(30^\circ C\). The strength of reactivity was graded as 0, 1, 2, 3, or 4, according to the percentage of granulocytes that agglutinated.

**Lymphocytotoxicity.** Lymphocytotoxicity (LC) was done using the standard National Institutes of Health method.\(^9\) The strength of the reaction in the crossmatch was graded as 0, 1, 2, 4, 6, or 8, based on the percentage of stained lymphocytes. Sera that had an incompatible LC crossmatch against donor cells were also screened against a panel of lymphocytes from 60 donors containing 20 HLA-A locus, 31 B locus, and eight C locus antigens. The percentage of the 60 panel cells that reacted was recorded, and the specificity of the HLA antibody reactivity determined by analyzing this pattern of reactivity.

**Granulocytotoxicity.** For granulocytotoxicity (GC), the method of Hasegawa et al\(^9\) was used, except that blood for preparation of the cell suspension was collected in acid-citrate-dextrose (ACD), granulocytes were isolated using a double-density Ficoll-Hypaque gradient,\(^5\) not papainized, and the sensitization phase of incubation was carried out at \(22^\circ C\) and \(37^\circ C\). The test was considered positive when more than \(40\%\) of cells were stained. The strength of reactivity was graded as 0, 1, 2, 4, 6, or 8 in relation to the percentage of stained granulocytes.

**Granulocyte immunofluorescence.** Granulocyte immunofluorescence (GIF) was done essentially as described by Verheugt et al,\(^11\) except that granulocytes were isolated using the double-density Ficoll-Hypaque gradient\(^5\) and not subjected to hypotonic lysis of red cells.

**Antibody-dependent lymphocyte-mediated granulocytotoxicity.** This was our modification of the method of Logue et al.\(^12\) Antibody-dependent lymphocyte-mediated granulocytotoxicity (ADLG) has been described in detail\(^12\) and is summarized here. Blood was drawn into heparin, and the mononuclear cells were isolated by a double-density Ficoll-Hypaque gradient separation. Phagocytic cells were removed by carbonyl iron, and the lymphocytes were isolated, washed, and suspended in McCoy’s medium containing \(15\%\) fetal bovine serum. Granulocytes were isolated by a double-density Ficoll-Hypaque gradient\(^5\), not papainized, and the sensitization phase of incubation was carried out at \(22^\circ C\) and \(37^\circ C\). The test was considered positive when more than \(40\%\) of cells were stained. The strength of reactivity was graded as 0, 1, 2, 4, 6, or 8 in relation to the percentage of stained granulocytes.

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**Studies Using \(^{111}\)Indium Granulocytes**

**Preparation and labeling of granulocytes.** Granulocytes for \(^{111}\)In labeling were processed, as previously described,\(^16\) with the use of a discontinuous Ficoll-Hypaque gradient from 125 mL ACD whole blood obtained by phlebotomy. The suspension contained an average of \(1 \times 10^8\) granulocytes with less than \(1\%\) mononuclear leukocytes and less than \(5\%\) red blood cells.

Indium-111-oxine was prepared as previously published.\(^16\) The granulocyte suspension was incubated with indium-111-oxine at room temperature for 20 minutes with occasional gentle mixing and then infused into the recipient.\(^16\) The small amount of labeled cell suspension remaining in the vial was used to determine labeling efficiency and the number of cells injected.

**Determination of intravascular recovery and \(t_1/2\).** Blood samples were obtained from the recipient at approximately ten minutes, 30 minutes, and 1, 2, 3, 4, 5, and 6 hours after injection, and the granulocyte-associated radioactivity was determined.\(^16\) Calculation of the percentage of injected granulocytes recovered in the circulation and their intravascular half-life (\(t_1/2\)) was based on total cell-associated activity injected and the recipient’s blood volume as previously described.\(^16\)

**Body scans.** Approximately 20 hours after injection of the indium-labeled granulocytes, the subjects underwent total body scanning using aClinex body scanner (Union Carbide, Danbury, Conn). With this technique, indium-labeled granulocytes are normally seen in the liver and spleen. Thus the scans were classified as follows: true negative—radioactivity in liver and spleen and no evidence of clinical inflammation found on follow-up; true positive—radioactivity in liver and spleen and at the site of inflammation present at the time of the scan; false positive—radioactivity in liver, spleen, and other sites in the absence of inflammation; false negative—radioactivity in the liver and spleen, with none at a site of inflammation present at the time of the scan. The presence or absence of inflammation was determined by continued follow-up of the patients and review of their entire clinical course by one of us (J. McCullough, C. Ludvigsen, L. Forstrom), who did not know the results of the scan when making the final decision regarding inflammation.

**Statistical analysis.** Patients were grouped based on the kind of antibody present and the presence or absence of neutropenia. Each group of patients with antibodies was compared with patients matched for the presence or absence of neutropenia but with no antibodies. The mean value for recovery and \(t_1/2\) for each group was determined, and differences between groups were evaluated by two-sample Student’s \(t\) test. The degree of the linear relationship between kinetics values (percentage of recovery and \(t_1/2\)) and the strength of individual crossmatch scores was determined using a Pearson CorrelationCoefficient test. Multiple regression analysis was used to examine the predictability of the association between combinations of crossmatch results and the kinetics values. The differences in kinetics values among the groups of patients who received HLA-mismatched transfusions were tested by two-sample Student’s \(t\) test. The relationship between positive and negative
results in the five leukocyte antibody tests was determined using two-by-two contingency tables. The statistical significance was calculated using chi-square with the Yates correction factor. Differences in all tests were considered significant if \( P < .05 \).

**RESULTS**

A total of 93 indium studies (partial results of 58 were previously reported in reference 17) was done in 38 adult and 45 pediatric patients (some patients were studied more than once). The patients had a variety of diseases, including aplastic anemia, acute or chronic leukemia, solid tumors, postoperative suspected localized infection or sepsis, or were post bone marrow transplant. Some patients were receiving platelet or granulocyte transfusions, and some were undergoing an indium scan to detect suspected occult infection. Leukocyte antibody testing and body scans were done in all 93 studies, and granulocyte kinetics data were obtained in 53 studies.

**Intravascular kinetics studies.** In our previous experience\(^7\) and in analyzing the present data, neutropenic patients had significantly reduced granulocyte recovery, and the presence of documented infection did not influence the intravascular recovery or \( t_{1/2} \). Therefore, patients in the present study were categorized based on the presence or absence of neutropenia (<1,000 PMN/μL), but not infection. In general, these patients were severely neutropenic. During 18 studies (Figs 1 and 2), the neutrophil count was known to be less than 1,000/μL but was not quantitated further. In the other 30 studies, the neutrophil counts were as follows: 1,000 to 500/μL, three studies; 500 to 200/μL, nine studies; and <200/μL, 18 studies.

In the 53 studies involving intravascular kinetics of indium granulocytes, no antibodies were detected in any of the five assays in 18 studies, nine in neutropenic, and nine in nonneutropenic patients (Figs 1 and 2). The average intravascular recovery and \( t_{1/2} \) in nonneutropenic patients (30.8% and 5.6 hours) were similar to our previous results in nonneutropenic patients without antibodies\(^7\) and in normal subjects who received autologous studies.\(^6\) In neutropenic patients, the average intravascular recovery (10.7%) and \( t_{1/2} \) (5.4 hours) were also similar to our previous data on neutropenic patients.\(^7\) In 18 studies, antibodies were detected by only one of the five methods, and in 17 studies, antibodies were detected by two or more methods (Figs 1 and 2). Compared with patients with no antibodies, there was a significant reduction in granulocyte recovery and \( t_{1/2} \) in the one nonneutropenic patient with only a GA antibody (6.7% v 30.8%; 0.3 hours v 5.6 hours) and in the four nonneutropenic patients who had a combination of GA plus other antibodies (9.7% v 30.8%; 0.3 hours v 5.6 hours). A statistically significant decrease in \( t_{1/2} \), but not recovery, also occurred in neutropenic patients with GA antibodies alone or in combination with others. Because of this demonstrated effect of GA antibodies, those patients were removed from the other groups in the remainder of this analysis.

One nonneutropenic patient had antibodies detected by GIF and other methods. The recovery (16.2%) and the \( t_{1/2} \) (1.4 hours) in this patient were significantly less than in comparable patients with no antibodies. The average recoveries in all other groups were not significantly less than in patients without antibodies. It should be emphasized that in the nine patients who had LC (HLA) antibodies alone or in combination with other antibodies, there was no significant reduction in the intravascular recovery or \( t_{1/2} \) of incompatible granulocytes when there was no accompanying granulocyte agglutinating activity (Figs 1 and 2). In four groups of neutropenic patients, either the recovery or \( t_{1/2} \) values were significantly higher than in the control patients with no
antibodies (Figs 1 and 2). In several of these situations, the data involved only one study. Six of the 14 patients involved had acute myelocytic leukemia and seven were infected. However, none had overwhelming infections or sepsis. No common features were apparent in these patients. Thus we believe that these statistically significant differences are probably due to the difficulty in standardizing all variables in these clinically ill patients and do not represent a causal relationship.

In order to analyze the relationship between multiple antibodies and the recovery or \( t'/2 \) of indium granulocytes, a multiple regression analysis was done comparing all possible combinations of antibodies with the recovery and \( t'/2 \). The presence of both GA and GIF antibodies had the best correlation with decreased recovery \( (R^2 = .49; P < .001) \); however, most of this effect was due to the GIF testing \( (GIF, R^2 = .47; GA, R^2 = .28) \). The combination of GA and GIF also had the best correlation with survival \( (R^2 = .73; P < .001) \); however, the GA and GIF made similar contributions \( (GA, R^2 = .61; GIF, R^2 = .58) \). In neutropenic patients, no combination of antibodies gave a correlation with recovery better than \( R^2 = .26 \).

The relationship between the strength of reactivity of the antibody and the recovery or \( t'/2 \) was analyzed. The Pearson Correlation Coefficient was used to test individual variables, that is, sera reactive in only one of the assays. Because the Pearson Correlation Coefficient requires a sample size of at least three, only GC testing could be analyzed. There was no significant relationship between the strength of GC reactivity and the percentage of recovery \( (P = .34) \) or the \( t'/2 \) \( (P = .29) \). Multiple regression analysis was used to study sera reactive in more than one assay. In neutropenic patients, there was a significant relationship between the strength of reactivity in the combination of GIF and LC assays and the recovery \( (R^2 = .62; P < .001) \). The strength of reactivity in the GIF alone was significantly related to the \( t'/2 \) \( (R^2 = .60; P < .001) \). Similar tests in neutropenic patients did not yield significant relationships possibly because the values for recovery in patients without antibodies were low and many studies would be necessary to show statistically significant differences.

Because of the relationship between the strength of reactivity of the LC and GIF with granulocyte recovery, and because of the wide availability of HLA (LC) testing, the role of HLA was investigated in more detail in several ways. The extent of reactivity of an HLA antibody can be determined not only by the degree of cytotoxicity against the individual donor cells in the crossmatch test, but also by the percentage of different random panel donors whose cells react. Those sera that reacted with 60% of different donors' lymphocytes were arbitrarily designated as highly reactive. Of 13 sera that reacted with <60% of panel donors, few reacted by GA, GIF, GC, or ADLG (Table 1), and the granulocyte recovery and \( t'/2 \) were normal in three of four patients studied. Of 15 sera that reacted with >60% of panel donors, 14 (93%) also reacted by GIF. This was consistent with the observation that there was a statistically significant relationship between LC and GIF results \( (P < .001) \) but not between LC and other methods \( (P > .05) \). The granulocyte recovery and \( t'/2 \) were reduced in six of the eight patients studied whose sera were highly reactive by LC. The remaining two sera associated with the normal recovery and \( t'/2 \) did not contain GA antibodies. However, three of the six sera associated with reduced recovery and \( t'/2 \) were also GA negative.

The effect of HLA antigen differences between donor and recipient was analyzed in combinations in which the donor's cells contained an antigen lacking in the recipient. The recovery and \( t'/2 \) for these combinations was compared with similar patients in whom either the HLA types of donor and patient were identical or the donor cells lacked an antigen that the recipient's cells contained.

There were 166 observations in which the patient's serum contained antibodies, but donor cells did not contain an HLA antigen lacking in the recipient (called matched, Table 2). There were 34 observations in which the patient's serum reacted against the donor's cells in at least one of the five assays and the donor cells contained an HLA antigen lacking in the recipient (called mismatched, Table 2). Significant findings involved HLA-A2 and BW44. There was a reduced \( t'/2 \) in the seven patients who received HLA-A2--incompatible granulocytes and reduced recovery and \( t'/2 \) in the three patients who received HLA-BW44--incompatible granulocytes.

**Table 1. Relationship of Reactivity of Sera in the LC (HLA) Test to the Reactivity in Other Tests and to Reduced Granulocyte Recovery (R) and Survival (1/2t)***

<table>
<thead>
<tr>
<th>Panel Donors Reactive (%)</th>
<th>Sera Reactive by (%)</th>
<th>Reduced R and ( t'/2 )</th>
<th>GC, ADLG</th>
<th>Reduced R and ( t'/2 )</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;60</td>
<td>13 8 23 38 31 1 of 4</td>
<td>1 of 4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>&gt;60</td>
<td>15 33 93 47 20 6 of 8</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Table 2. Influence of Donor–Recipient Mismatching for Selected HLA Antigens on the Recovery and Survival of 111-Indium Granulocytes***

<table>
<thead>
<tr>
<th>HLA Antigen</th>
<th>Matched Donor Recipient Recovery (%)</th>
<th>Mismatched Donor Recipient Recovery (%)</th>
<th>Matched Donor Recipient ( t'/2 ) (hours)</th>
<th>Mismatched Donor Recipient ( t'/2 ) (hours)</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>n 16 12.5 4 14.2 13 2.1 4 2.4</td>
<td>n 10 3.2 7 0.6 2 2.2</td>
<td>n 15 2.2 2 2.2</td>
<td>n 15 2.3 2 0.4</td>
</tr>
<tr>
<td>B</td>
<td>n 18 23.8 2 11.6 0 2 2.2</td>
<td>n 13 2.4 2 2.2</td>
<td>n 15 2.4 2 0.4</td>
<td>n 16 2.1 2 1.6</td>
</tr>
<tr>
<td>C</td>
<td>n 15 12.9 5 12.6 13 0.2 2.4</td>
<td>n 15 2.2 2 2.2</td>
<td>n 15 2.4 2 0.4</td>
<td>n 15 2.3 2 0.9</td>
</tr>
<tr>
<td>D</td>
<td>n 17 12.6 3 14.4 15 2.2 2.2</td>
<td>n 15 2.2 2 2.2</td>
<td>n 15 2.4 2 0.4</td>
<td>n 15 1.9 2 3.8</td>
</tr>
<tr>
<td>B8</td>
<td>n 18 13.9 2 3.8 15 2.2</td>
<td>n 15 2.2 2 2.2</td>
<td>n 15 2.4 2 0.4</td>
<td>n 15 2.3 2 0.9</td>
</tr>
<tr>
<td>BW44</td>
<td>n 17 14.7 3 2.4</td>
<td>n 14 2.6 3 0.2</td>
<td>n 15 2.4 2 0.4</td>
<td>n 15 2.3 2 0.9</td>
</tr>
<tr>
<td>B15</td>
<td>n 19 12.4 1 21.3 16 2.2</td>
<td>n 15 2.2 2 1.6</td>
<td>n 15 2.4 2 0.4</td>
<td>n 15 1.9 2 3.8</td>
</tr>
<tr>
<td>B35</td>
<td>n 17 12.0 3 17.7 15 2.2</td>
<td>n 15 2.2 2 2.2</td>
<td>n 15 2.4 2 0.4</td>
<td>n 15 2.3 2 0.9</td>
</tr>
<tr>
<td>B40</td>
<td>n 17 11.8 3 19.1 15 2.2</td>
<td>n 15 2.2 2 2.2</td>
<td>n 15 2.4 2 0.4</td>
<td>n 15 1.9 2 3.8</td>
</tr>
<tr>
<td>Total</td>
<td>n 166 34 126 27</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Results shown are from 34 studies involving 18 patients whose serum reacted in one or more of the leukocyte antibody assays compared with 166 studies in 20 patients with antibodies in one or more leukocyte antibody assays and matched for selected HLA antigens.

* \( P < .05 \).
cytes. Both the recovery and t\(\frac{1}{2}\) in HLA-B8 mismatched were reduced but not statistically significant \((P = 0.06)\). Because of the observed effect of GA antibodies on recovery (Fig 1), the six patients with reactivity in the GA assay were excluded and the data on the remaining 12 studies was reanalyzed. Similar results were obtained; that is, there was a significant reduction in recovery and t\(\frac{1}{2}\) with HLA-A2 and BW44 positive cells (data not shown).

Serum that react by LC often have broad reactivity and their HLA antigen specificity cannot be determined. Four patients who had HLA antibodies of clear specificity received granulocytes that contained the corresponding antigen: HLA-A2 (two cases) and A24 (two cases) (Table 3). None of the patients had GA reactivity, so that was not a confusing factor. In three patients (1 through 3), two with anti-HLA-A2 and one with anti-HLA-A24, it appears that the recovery of the incompatible donor cells was reduced and the t\(\frac{1}{2}\) was shortened, although P values were not calculated because of the small number of studies done.

**Tissue localization.** Ninety-three indium scans were done, 45 of which were in patients determined to have localized inflammation at the time of the study. No antibody was detected by any of the five methods in 27 of the 93 studies. Thirty-two studies were done on the same patient at different times. Excludes GA antibodies.

| Patient | Neutropenic | Sera Reactivity by Antibody | Patient Neutropenic | Tissue localization of indium-granulocytes in the esophagus and colon. This is the only true positive scan we have seen in the presence of a GA antibody in more than four years of study. The antibody reacted weakly and gave an unusual, loose-agglutinating antibody with only a few cells in each agglutinate, which may account for their ability to localize in vivo.

**GA antibodies were present with others in 12 studies (Table 4). Six were true negatives and the previously mentioned child had a second positive scan at a time when the serum reacted by GC as well as by GA. Two patients had false negative scans. One had clinically apparent submandibular cellulitis and one, osteomyelitis at a leg amputation stump. A third patient is classified as both false negative and false positive. This 22-year-old female post renal transplant because of juvenile-onset diabetes had an intra-abdominal abscess at which indium granulocytes failed to localize (false negative) but showed pulmonary sequestration of indium granulocytes in the absence of evidence of pulmonary inflammation (false positive). Two additional patients with GA antibodies had abnormal pulmonary sequestration of indium granulocytes, and thus were classified as false positives. One was a 72-year-old man with chronic autoimmune neutropenia (Fig 3), whose serum reacted in the GA, GC, GIF, and ADLG tests. The intravascular recovery of granulocytes was reduced to 4.6% (normal, 10.7%), and their survival was short (t\(\frac{1}{2}\), 0.2 hours; normal, 5.4 hours). Severe abnormal bilateral pulmonary uptake of indium granulocytes was apparent throughout the 24 hours postinjection. The other was a 9-year-old female post bone marrow transplantation for acute myelogenous leukemia. Neither patient had evidence of pulmonary inflammation and neither was on any drug that was likely to cause pulmonary toxicity. All of these patients who had false negative or false positive scans had serum reactivity in the GA and GIF assays. Many patients whose serum reacted in one or more other tests had true positive scans and none had false negative or false positive scans (Table 4).

**DISCUSSION**

In this study, granulocyte agglutinating antibodies alone and in combination with other leukocyte antibodies were present.

**Table 3. Influence of Donor-Recipient Mismatching for HLA Antigens on Recovery and Survival of 111-Indium Granulocytes**

<table>
<thead>
<tr>
<th>Antibody</th>
<th>n</th>
<th>Recovery t(\frac{1}{2})</th>
<th>Recovery t(\frac{1}{2})</th>
</tr>
</thead>
<tbody>
<tr>
<td>GA</td>
<td>4</td>
<td>10.7</td>
<td>5.4</td>
</tr>
<tr>
<td>GC</td>
<td>12</td>
<td>10.7</td>
<td>5.4</td>
</tr>
<tr>
<td>GIF</td>
<td>4</td>
<td>10.7</td>
<td>5.4</td>
</tr>
<tr>
<td>ADLG</td>
<td>11</td>
<td>9</td>
<td>5.4</td>
</tr>
</tbody>
</table>

Results are shown from 32 patients with antibodies detected by only one of the five methods and 34 patients with antibodies detected in different combinations of two or more methods.

†These studies represent 34 patients. Because the data is grouped to show different combinations of antibodies, the total appears greater.

‡These two studies were done on the same patient at different times.
associated with decreased intravascular recovery and survival of incompatible granulocytes. In addition, antibodies detected by GA in combination with GIF were associated with failure of granulocytes to localize at sites of inflammation or with abnormal pulmonary sequestration, or both.

Analysis of the data in this manner did not indicate an important role for LC testing and the HLA system in granulocyte destruction, lack of migration to inflammatory sites, or abnormal pulmonary sequestration. However, because HLA antigens are found on granulocytes and there is widespread use of LC testing, we analyzed donor recipient combinations in which the donor's granulocytes contained HLA antigens lacking in the recipient. In patients whose serum reacted in one or more of the antibody assays, mismatching for HLA-A2, B8, or BW44 was associated with reduced recovery and survival of injected granulocytes. In four patients it was possible to examine the effects of the specific HLA antibodies anti-A2 and A24. There was a strong suggestion that these antibodies were associated with a reduced recovery and survival of donor granulocytes containing the corresponding antigen. Sera reactive by LC (HLA) against a broad range of panel donors (>60%) also were associated with reduced recovery and t½. There was a statistically significant association between reactivity of these sera and reactivity by GIF. Thus the combination of LC and GIF may define a group of highly immunized patients in whom the recovery and survival of injected granulocytes are reduced.

Ungerleider et al14 found that neither the increment in granulocyte count after transfusion nor transfusion reactions were related to the presence of leukocyte antibodies detected by GC, LC, leukoagglutination, or capillary agglutination.
ACKNOWLEDGMENT

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Effect of leukocyte antibodies and HLA matching on the intravascular recovery, survival, and tissue localization of 111-indium granulocytes

J McCullough, M Clay, D Hurd, K Richards, C Ludvigsen and L Forstrom